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SOLAR PHYSICS OBSERVATORY

FOURTH ANNUAL REPORT OF THE DIRECTOR OF THE SOLAR PHYSICS OBSERVATORY TO THE SOLAR PHYSICS COMMITTEE

1916 APRIL 1—1917 MARCH 31

Fourth Annual Report of the Director of the Solar Physics Observatory

4 *June* 1917.

The Vice-Chancellor begs leave to publish to the Senate the following Report which the Solar Physics Committee have received from the Director of the Solar Physics Observatory:

The Report here presented relates to the year 1916 April 1 to 1917 March 31.

The Assistant Director, Mr Stratton, has been absent the whole year; as Major in the Royal Engineers (20th Signal Company) he has been with the British Expeditionary Force in France; he was mentioned again in Sir Douglas Haig's despatches and was awarded the D.S.O. on 1917 January 1. The First Junior Observer, Mr W. E. Rolston, who received his commission and left the Observatory in 1915 June to join the 2/5th Weald of Kent Battalion (The Buffs), was gazetted Captain on 1916 April 12 and is now with the British Expeditionary Force in France. The Second Junior Observer, Mr W. Moss, left the Observatory 1916 March 29 and still continues his duties in the Inspection Department at Woolwich Arsenal. The Resident Attendant, W. H. Manning, is still engaged in munition work.

The apparatus taken to the Crimea in July 1914 still remains at Odessa.

A. *Stellar Work.*

Observational work with the Newall Telescope has been in abeyance throughout the year. Work with the Huggins Telescope which can be satisfactorily used by a single observer is being resumed; the sparking apparatus for comparison spectra in stellar spectrograms has been completed in the workshop from the designs of the Director, and is found to be quite satisfactory in use.

A long series of photographs of spectra of various carbon compounds has been investigated with a view to finding lines due to carbon in some form and not hitherto recorded as such. A summary of the results and of the relation of known forms of the spectra of carbon and its compounds to celestial spectra of various types is being prepared. More experimental work in the laboratory is needed for the elucidation of the conditions under which the lines and bands are formed.

Verification of the identification of the absorption band in the Solar Spectrum near Fraunhofer's line G with the emission band at 4314 usually ascribed to hydrocarbon, and seen in the spectrum of the base of a candle flame, was accomplished very shortly after last year's report was presented. A preliminary note containing the photographic evidence in the form of a plate, which showed a negative of the head of the band due to the candle flame alongside of a positive of the corresponding region in the solar spectrum, was presented to the Royal Astronomical Society in June last (*Monthly Notices*, vol. 76, 640).

The work of the revision of the origins assigned to solar lines in Rowland's Tables of Solar Spectrum Wave-lengths has been continued by Mr Baxandall, special attention having been given to the lines assigned to iron.

A series of 37 photographs of the spectrum of β Lyrae, taken in 1893–5, has been studied by Mr Baxandall, with special reference to an attempt to assign different lines to separate components in a system consisting of two or more stars. The work of Shapley on the variation of the spectra of Cepheid variables has also been carefully studied in its bearing on modern views of the evolution of the stars.

Frequent attempts were made during June to photograph the spectrum of Venus with the McClean solar instruments. The opportunities of observation were limited, partly by the high declination of the planet at the times most favourable for the scale of the image and angular distance from the sun, and partly by the unpropitious weather prevalent when the planet attained declinations accessible to instruments which were designed specially for solar work involving declinations below 25° N. No results of value were obtained.

B. *Solar Work.*

Spectroheliograph. Photographs of the sun's disc in $K_{2.3.2}$ light have been obtained on 117 days (previous year, 112), and photographs of the prominences at the limb on 104 days (previous year, 93). The work has been in the charge of Mr Butler, assisted occasionally by L. J. Stanley.

Several remarkable outbursts of solar activity have occurred during the year; and though there have also been intervals of remarkable quiescence the activity in general has continued to increase.

The 18-inch and 6-inch mirrors were dismounted on 1916 April 12, and replaced on April 20 after being resilvered. The 12-inch photovisual objective was dismounted on October 26, and the efflorescent crystals which had accumulated in considerable quantities between the component lenses were removed. The objective was remounted on the same day.

The Director of the Kodaikanal Observatory has forwarded 329 spectroheliograms showing the solar disc in calcium ($K_{2.3.2}$) light for the year 1916 January 1—December 31 relating to 329 days (previous year 322). Of the 37 days missed in the Kodaikanal records there are Cambridge records for 16 days, so that solar records for calcium flocculi are available for 345 days in 1916 (previous year, 337).

The set of 81 negatives for the months of July, August, September 1916 has not been received, having been lost with a mail boat. A request has been made for positive copies from the Kodaikanal negative records for these days, so that negative copies can be made to complete the set at Cambridge.

Photoheliograms. Daily photographs taken with the Dallmeyer photoheliograph at Dehra Dûn have been received. The negatives are stored at the Science Museum, South Kensington. The positive prints on paper have also been received from Dehra Dûn; but the work of mounting is in abeyance, as in last year.

A set of prints and a consignment of negatives appear to have been lost with a mail boat.

C. *Meteorological Physics.*

Investigations in Atmospheric Electricity. The results of Mr C. T. R. Wilson's investigations on lightning discharges referred to in last year's report were published in the Proceedings of the Royal Society (A, Vol. 92, pp. 555—574).

Apparatus for recording photographically various changes of interest in the study of atmospheric electricity was constructed in the Observatory workshop and has been in use since August last. The trace recorded on the moving photographic plate is a record of the total integrated current that passes through a wire connecting an exposed conductor to the earth. The exposed conductor is, at the choice of the observer depending on the object of the observations, either an earth-filled sieve with its upper surface level with the surrounding ground, or a copper sphere raised to a height of $15\frac{1}{2}$ feet above the ground. Momentary shielding, at convenient intervals, of the conductor from the earth's electric field gives a series of points on a second curve, of which the ordinates supply a record of the quantity of electricity which has passed from the atmosphere to earth whether by conduction

by ions or by convection by charged raindrops, snow, &c.—the difference between the ordinates of the two curves (exposed, and shielded) being a measure of the electric field.

The speed of movement of the photographic plate can be adjusted within fairly wide limits. At present the apparatus is intended mainly for quick runs, that is, for open time scale, which can be calibrated by measurement of the intervals between the marks recorded when the light is periodically cut off from the photographic plate or when the conductor is periodically shielded. It records even very rapid changes in the electric field—changes lasting only a fraction of a second.

Accumulative improvements have been made throughout the year as a result of the experience gained, the primary aim being to produce as efficient an instrument as possible for the study of thunderstorm-electricity during the coming summer months. Meanwhile a considerable number of records of interest have been obtained of the electric field and of the quantity of electricity passing from the atmosphere to the earth both in fine weather and during showers of snow and rain.

D. *Work in the Laboratory.*

The work referred to in last year's report on the hydrocarbon band has been brought to a successful conclusion in its first stage. Photographs taken with the spectrograph of high dispersion required very long exposures, from eleven to fifty hours, and they suffered in definition in consequence of the shifting of the spectrum during exposure. This has been in large measure remedied by providing round the prism box a felt jacket and an electric heater arranged in coils of wire in the cover, so as to secure uniformity of temperature. As has been stated in an earlier paragraph a preliminary account of the successful identification of the group of lines near Fraunhofer's group G in the solar spectrum with the hydrocarbon band λ 4314 was communicated to the Royal Astronomical Society in June.

The work is now extended to the second stage, being directed to an investigation of the origin and conditions of occurrence of the various known types of spectra of carbon compounds, with special reference to the band at wave-length 4314 generally ascribed to hydrocarbon.

For this work a suitable spectrograph of small dispersion has been successfully elaborated, mainly from portions of the laboratory spectrograph presented by the late Lady Huggins. It records the spectrum from λ 3600 to λ 6600 on a single curved plate, with a separation of 90 mm. between those limits of wave-length, and gives very satisfactory definition throughout this long range of spectrum. The work is being carried on by Mr Butler.

E. *Miscellaneous.*

A number of valuable publications have been received in the course of the year, and the Director desires to record his grateful acknowledgments to the donors. A list is appended.

At the request of the Meteorological Section of the Royal Flying Corps regular observations of pilot balloons are being made in the early morning between 7 and 8 o'clock, for determinations of the direction and velocity of the wind in the higher strata of the air. The observations are being made by Mr Wilson and Mr Butler, with L. J. Stanley as recorder.

H. F. NEWALL.

Solar Physics Observatory,
1917 *May* 26.

The Director gratefully acknowledges the receipt of the following works, which have been presented to the Library of the Solar Physics Observatory:

Astronomy.

	Donors.
Allegheny Observatory, Pa. Publications. Vol. III. Nos. 22, 23. Lancaster, Pa., 1916. 4to.	The Observatory.
Astrophysical Journal. Vol. XLIII. No. 4—Vol. XLIV. No. 5. Chicago, 1916–17. 8vo.	Prof. Newall.
Bourges. Observatoire. La Revue du Ciel. Nos. 2, 4, 5. (Cher) France. 8vo.	The Observatory.
Brera, Reale Osservatorio di Brera in Milano. Pubblicazioni. No. LIV. 1916. Milan, 1916. 4to.	,,
Cape of Good Hope, Royal Observatory. Report of H.M. Astronomer, 1914, 1915. London, 1915–16. Fscp.	,,
Copenhagen, Observatorium. Publikationer og mindre Meddelelser. Nos. 24—26. Kobenhavn, 1915–16. 4to.	,,
Copenhagen, Universitets Astronomiske Observatorium. Ephemeriden-Zirkular der Astronomische Nachrichten. (Temporary publication of the Kiel Centralstelle ephemerides, etc.) Nos. 508, 510, 512, 513, 514. Kiel, 1916. 4to.	,,
Edinburgh, Royal Observatory. Annual Report, No. 26. Edinburgh, 1916. 8vo.	,,
Greenwich, Royal Observatory. Annual Report of Astronomer Royal, 1915—1916. London, 1916. 4to.	,,
Harvard College Observatory. Annals. Vol. LXXIII. Part 3; Vol. LXXVI. Parts 11, 12, and Cover and Preface; Vol. LXXXIV. Part 1. Cambridge, Mass., 1915–16. 4to.	,,
Harvard College Observatory. Bulletins. Nos. 596—613. Cambridge, Mass., 1915–16. 4to.	,,
Harvard College Observatory. Circulars. Nos. 191—200. Cambridge, Mass., 1916–17. 4to.	,,
Hyderabad, Nizamiah Observatory. Annual Report, 1915–16. Hyderabad, 1916. 8vo.	,,
Johannesburg, Union Observatory. Circulars. Nos. 34, 35. Johannesburg, 1916. 4to.	,,
Kodaikanal Observatory. Bulletins. Nos. 49—52. Madras, 1916. 4to.	,,
Laws Observatory. Bulletins. Nos. 24, 25. Columbia, Miss., 1916. 4to.	University of Missouri.
Lick Observatory. Bulletins. Contents and Index to Vol. VIII. Nos. 281–288. Berkeley, Cal., 1916–17. 4to.	The Observatory.
London, Royal Astronomical Society. Monthly Notices. Vol. LXXVI. Nos. 6—9; Vol. LXXVII. Nos. 1—3. London, 1916–17. 8vo.	The Society.
Lowell Observatory, Arizona. Bulletin. Nos. 73—75. Flagstaff, 1916. 4to.	The Observatory.
Ottawa, Dominion Observatory. Publications. Vol. III. Parts 6, 7. Ottawa, 1916. 4to.	,,
Rio de Janeiro, Observatorio Nacional. Annuario. 1916, No. XXXII. Rio de Janeiro, 1916. 8vo.	,,
Tortosa. Observatorio del Ebro, Roquetas, Spain. Boletín Mensual. Vol. VI. Nos. 3—12; Vol. VII. Nos. 1—4. Tortosa, 1915–17. 4to.	,,
Washington, United States Naval Observatory. Annual Report, 1916. Washington, 1916. 8vo.	,,
Zurich, Sternwarte des eidg. Polytechnikums. Astronomische Mitteilungen. No. 106. Zurich, 1917. 8vo.	,,

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Argentina, Servicio Meteorologico. Historia y Organizaeion. Buenos Aires. 1914. 4to.	The Office.
Argentina, Oficina Meteorologica. Anales. Vol. XV. Parts 1 and 2; Vol. XVII. Parts 1 and 2. Buenos Aires, 1912–13. 4to.	,,
Argentina, Oficina Meteorologica. Boletin Mensual. 1916. Nos. 1—4. Buenos Aires, 1916–17. 4to.	,,
Australia, Commonwealth Bureau of Meteorology. Bulletin, Nos. 11, 12, 13. Melbourne, 1916. 4to.	The Bureau.
Australia, Commonwealth Bureau of Meteorology. Maps. Rainfall, 1915. Sydney, 1916.	,,
Australia, Commonwealth Bureau of Meteorology. Monthly Weather Report. Vol. III. No. 12; Vol. IV. Nos. 1, 2. Sydney, 1916. 4to.	,,
Bologna, Osservatorio della R. Università. Osservazioni Meteorologiehe, 1913, 1914. Bologna, 1914–15. Fol.	The Observatory.
Brera, R. Osservatorio astronomico di Brera in Milano. Osservazioni Meteorologiche e Geofisiche. Vol. VII. Milano, 1916. 4to.	,,
Canada, Dominion Meteorological Service. Monthly Weather Review. Vol. XL. Nos. 1—9. Toronto, 1916. 4to.	Department of Marine and Fisheries.
Canada, Meteorological Serviee. Reports, 1913. Ottawa, 1916. 4to.	,,
Christiania, Norske Meteorologiske Institut. Nedboriagttagelser i Norge. Aargang XXI., 1915. Kristiania, 1916. Fol.	The Institute.
Edinburgh, Scottish Meteorological Society. Journal. Vol. XVII. Edinburgh, 1916. 8vo.	The Society.
Holland, Institut météorologique royal. Caractère Magnétique de chaque jour des mois. 1916. Quarters 1 and 3, and Addition to years 1914, 1915, 1916. de Bilt, 1916–17. Fol.	The Institute.
India, Meteorological Department. Memoirs, Vol. XIX. Table of Contents; Vol. XXI. No. 14, Calcutta, 1908–15 and 1916. 4to.	The Indian Government.
India, Meteorological Department. Memoranda on Monsoon and Weather Conditions in India, 1916 (Monsoon). June—Sept. 1916 and Jan.—Feb. 1917 (Weather). Simla, 1916–17. Fcp.	,,
India, Meteorological Department. Monthly Weather Review. 1915, Nov., Dec.; 1916, Jan.—June. Calcutta, 1916. 4to.	,,
India, Meteorological Department. Statements of Rainfall. 1916. Jan. Feb. and June to Sept. Simla, 1916. Fcp.	,,
India, Meteorological Department. Rainfall Data, 1915. Calcutta, 1916. Fcp.	,,
London, Meteorological Committee. Eleventh Annual Report to the Lords Commissioners of His Majesty's Treasury for the year ending 31st March, 1916. London, 1916. 8vo.	The Committee.
London, Meteorological Committee. Monthly Weather Reports. 1916, Mareh—1917, Feb. London, 1916—1917. 4to.	,,
London, Meteorological Committee. Weekly Weather Reports. 1916, April 2—1917, Mar. 24. London, 1916—1917. 4to.	,,
London, Meteorological Committee. Daily Weather Reports. 1916, April—1917, March. London, 1916—1917. 4to.	,,
London, Meteorological Committee. British Meteorologieal and Magnetic Year-Book. Part III, Seetion 1. Daily readings at Meteorological Stations of the first and second orders. 1915. London, 1916. 4to.	,,
London, Meteorological Committee. British Meteorological and Magnetic Year-Book. Part III, Section 2. Geophysical Journal. 1915. Nos. 1—6. London, 1916—1917. 4to.	,,

Mauritius, Royal Alfred Observatory. Annual Report, 1915. Mauritius, 1916. Fscp. — The Observatory.

Mauritius, Royal Alfred Observatory. Results of the Magnetical and Meteorological Observations. 1916, Jan.—Sept. Mauritius, 1916. 4to. — ,,

Montecassino, Osservatorio Meteorico-Aerologico-Geodinamico. Bolletino Mensile. 1915, Aug.—Dec.; 1916, Jan.—July. Cassino, 1915–16. 4to. — ,,

New Zealand, Government Meteorological Observatory. Meteorological Tables from the New Zealand Gazette. 1916, May to Dec.; 1917, Jan. to March; 1915, Yearly Summary. Wellington, 1916–17. Fscp. — ,,

Oxford, Radcliffe Observatory. Results of Meteorological Observations. 1911—1915, Vol. li. Oxford, 1916. 8vo. — ,,

Southport, Fernley Observatory. Report and Results of Observations. 1915. Southport, 1916. 8vo. — ,,